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Complete Specification entitled (54) TWO OR MORE SPEED GEAR BOX FOR POWER OPERATED TOOLS

(Additional to 291,766)

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Related Art (56)

283,210(45,885/64)	60.2
285,429(45,886/64)	60.2.

The following statement is a full description of this invention, including the best method of performing it known to us:

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W. G. Murray, Government Printer, Can

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11,095/66

This invention relates to a two or more speed gear box for power operated tools, and constitutes an improvement in or modification of the invention according to pending Australian patent No. 291,766.

The specification for patent No. 291,766 discloses a gear box of the above kind in which a pair of continually intermeshing gear clusters are respectively mounted on a driving shaft and a driven shaft. The gears of one cluster are fixed against rotation relative to their respective shaft, and the gears of the other cluster are rotatable relative to each other and to their respective shaft. The gears of at least one cluster are of different diameter so as to provide a plurality of possible speed ratios between the two shafts. Clutch means is provided for positively coupling any one gear of the free closure to each of its respective shaft, and a change-over mechanism is also provided to enable selective coupling of the clutch means to any one gear of the free cluster.

It is a primary object of the present invention to provide a gear box of the above kind which is an improvement in or modification of the gear box according to Patent No. 291,766 , and in which simple and effective means is provided for neutralizing the clutch means during a change-over from one gear ratio to another gear ratio. The gear box of the present invention is ideally suited for use in electric motor driven drills of the portable type, and for convenience, the invention will be hereinafter described in relation

to such drills. It is to be understood however, that the gear box according to the invention is not limited to the particular use described.

In accordance with the present invention there is provided a two or more speed gear box according to claim 1 of Australian Patent No. 291,766, wherein neutralizing means is provided on said other shaft so as to be engageable with said key member during a change-over from any one gear ratio to another, said neutralizing means being operable during said engagement to retain said key member in an inoperative or neutral position.

In order that the invention will be readily understood, a preferred practical embodiment thereof will be hereinafter described with reference to the accompanying drawings in which:

Figure 1 is a sectioned side elevational view of a gear box according to the invention;

Figure 2 is a sectional view taken along line 11-11 of Figure 1;

Figure 3 is a sectional view taken along line III-III of Figure 1;

Figure 4 is a view similar to Figure 3, but showing the driven shaft in a different rotational position; and

Figure 5 is a sectional view taken along line V-V of Figure 4.

A gear box of the type to which the present invention is applicable includes driving and driven

shafts 2 and 3 respectively rotatably mounted in a gear box housing 4, and separate gear clusters 6 and 7 are mounted on the shafts 2 and 3 respectively. In use, the gear box housing 4 is removably secured to the main body 8 or the drill which houses the electric motor. Alternatively, the housing 4 and main body 8 of the drill may be formed as a single casing which is split lengthwise for separation to allow maintenance of parts.

The gear clusters are drivably engageable and each gear cluster includes a plurality of gears of different diameters by means of which several different gear ratios can be obtained. At least one of the gear clusters is operatively connected to change-over mechanism whereby any one of the possible gear ratios can be selected. In use the driving shaft 2 is operatively connected to the motor spindle 9 through a suitable coupling.

The driving shaft 2 is preferably adapted to extend substantially parallel to the motor spindle 9 when in use, and has its opposite ends rotatably mounted in bearings provided in the wall of the housing 4 and the drill body 8 respectively. It is to be realised however, that the driving shaft 2 could be mounted so as to extend at an angle to the rotational access of the motor spindle 9.

The coupling connecting the driving shaft 2 to the motor spindle 9 may include a pair of continually intermeshing gears 11 and 12 secured to the motor spindle 9 and the driving shaft 2 respectively.

The driven shaft 3 preferably extends substantially

parallel to the driving shaft 2, and in one form has one end adapted to be rotatably mounted in a bearing provided in the drill body 8 and the other end extending through another bearing 13 in a wall of the housing 4 for connection to a chuck or other drill holding device (not shown).

The gear clusters 6 and 7 are in continual intermeshing engagement. As previously mentioned, each cluster includes a plurality of gears of different diameters according to the number of desired ratios, and in the cluster 6 (hereinafter referred to as the fixed cluster), gears 14, 15 and 16 are secured together for simultaneous rotation, whereas in the gear cluster 7 (hereinafter referred to as the free cluster) gears 17, 18 and 19 are separate integers capable of rotation independently of one another.

Preferably, the fixed and free clusters 6 and 7 are mounted on the driving and driven shafts 2 and 3 respectively. The fixed cluster 6 is secured against lengthwise movement relative to the driving shaft 2 and is also preferably mounted for rotation with the driving shaft 2.

The separate gears of the free cluster 7 are rotatably mounted on the driven shaft 3 and are in continual mesh with their respective or associated driving gears of the fixed cluster 6: there being a corresponding number of driving and driven gears. Although the driven gears 17, 18 and 19 are capable

of relative rotation, they are nevertheless held against substantially lengthwise movement relative to the driven shaft 3 and to their associated driving gears 14, 15 and 16. This may be achieved by any suitable means such as a shoulder 21 formed on the driven shaft 3 which abuts one end of the free cluster 7, and a stop member (not shown) removably secured to the driven shaft 3 so as to abut the other end of the free cluster 7.

Clutch means is provided for selectively and positively coupling any one of the gears 17, 18 and 19 of the free cluster 7 to the driven shaft 3. The clutch means preferably includes a key member 22 which can be selectively positioned for engagement with any one of the driven gears 17, 18 and 19 while remaining in continual positive engagement with the driven shaft 3.

The key member 22 preferably has a body portion 23 which is substantially square or rectangular in cross sectional shape and has substantially parallel side surfaces. A gear engaging portion 24 projects above an outer surface of the body portion 23, preferably adjacent one end thereof, and the distance between the outer surface of the gear engaging portion 24 and the inner surface of the body portion 23 is preferably greater than the width of the key member 22.

In an alternative arrangement, the key member 22 may be of substantially the same rectangular shape

and size throughout its entire length. With such a key member, it is preferred that the distance between its inner and outer surfaces is greater than the distance between its side surfaces.

The key member 22 is located within a substantially parallel sided slot 26 formed in the surface of the driven shaft 3 and extending in the axial direction thereof. The slot 26 has a width sufficient to slidably receive the key member 22 and has a depth at least equal to the maximum height of the key member 22 (i.e., distance between inner and outer surfaces) for a purpose hereinafter described.

Resilient means may be provided for normally urging the key member 22 radially out of the slot 26 so as to engage within any one of keyways 27, 28 and 29 provided in the driven gears 17, 18 and 19 respectively. In a preferred form, the resilient means consists of a plate or leaf spring 31 interposed between the inner surface of the key member 22 and the base of the slot 26.

Obviously, any other appropriate means distinct from resilient means may be provided for urging the key member in the desired direction.

The keyway in each driven gear is adapted to slidably receive portion 24 of the key member 22 and has a depth less than the maximum height of the key member 22. That is, the depth of each driven gear keyway is preferably such that the gear engaging portion 24 is contained within that keyway whilst

the body portion 23 of the key member 22 remains within the slot 26. Thus, the intention is that the key member 22 in its outermost position crosses the parting line between a driven gear and the driven shaft 3 so as to produce a positive driving connection between those integers.

Neutralizing means includes a guide member interposed between the keyways of each two adjacent driven gears, and arranged to retain the gear engaging portion 24 of the key member 22 out of engagement with both of the keyways until the longitudinal position of that portion 24 relative to the driven gears is such that it is adapted for engagement within only one of the keyways.

Preferably, each guide member is in the form of an annular washer 51 having an inside diameter substantially the same as the diameter of the bore of the driven gears 17, 18 and 19. Thus, the washer 51 is rotatably mounted on the driven shaft 3, although it might be firmly secured to the shaft 3 if so desired. A guide washer 51 may be interposed between the adjacent end faces of each two adjacent driven gears 17 and 18, and 18 and 19 respectively so as to act as spacers as well as guides. It is preferred however, that each washer 51 is mounted within a recess 52 formed in an end face of the driven gears 17 and 18, thereby enabling the overall length of the driven gear cluster 7 to be kept to a minimum.

In an alternative arrangement (not shown), the

keyway of each driven gear may extend from one end face of the gear and terminate at an end wall adjacent the other end face of the gear. The end walls so formed act as the guide members.

The clutch means is operatively connected to manually operable change-over mechanism whereby the desired gear ratio can be selected at will. In a preferred form, the change-over mechanism includes a selector rod 32 slidably mounted in the housing 4 so as to have its longitudinal axis substantially parallel to that of the driven shaft 3, and having an operating end 33 projecting through the wall of the housing 4 for engagement by an operator.

Means for connecting the selector rod 32 to the key member 22 may include a sleeve 34 slidably mounted on the driven shaft 3 and a substantially rigid member such as a bar, or an extension 36 of the aforementioned leaf spring 31, secured at its opposite ends to the sleeve 34 and the key member 22 respectively. A fork member 37 secured at one end to the selector rod 32 and having its bifurcated end straddling and operatively engaging the sleeve 34, enables the sleeve 34 and consequently the key member 22, to be moved axially of the driven shaft 3 in accordance with axial movement of the selector rod 32.

A recess 38 may be formed in the outer surface of the housing 4 so as to accommodate the operating end 33 of the selector rod 32 and thereby minimize the chances of inadvertent operation of the change-over

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Hold-in or retaining mechanism is preferably provided for retaining the selector rod 32 in any one of a number of positions corresponding to positions of the key member 22 in which a different gear ratio is rendered operative. According to one form, the hold-in mechanism includes a spring 39 normally urging the operating end 33 of the selector rod 32 out of the housing 4, and a stop 41 for limiting the outward movement of the operating end 33 to a position in which a first gear ratio is selected. The stop 41 may be formed by the inside surface of the housing wall and a part of the fork member 37 adapted to abut against that inside surface.

In order to retain the selector rod 32 at positions in which other gear ratios are selected, the hold-in mechanism may also include a separate spring influenced locking pin 42 for each gear ratio additional to the first. The locking pins 42 are slidably mounted in individual bores 43 formed in the housing wall so as to be open at one end and closed at the other end.

The bores 43 extend transversely in relation to the longitudinal axis of the selector rod 32 so as to be in alignment therewith, and are spaced apart a distance substantially equal to that moved by the selector rod 32 in changing from one gear ratio to another. Each pin 42 may include an enlarged head portion 44 which is located within its respective bore 43, and a bush 46 or other means is secured within the

open end of the bore 43 so as to be engaged by the head portion 44 and thereby normally prevent complete removal of the pin 42 from the bore 43.

A compression spring 47 may be located between the head portion 44 and closed end of the bore 43 so as to normally urge the pin 42 out of its respective bore 43 to the maximum extent. The arrangement is such that each pin 42, in its fully extended position, is adapted to engage the operating end 33 of the selector rod 32.

Having now described the main components of a practical embodiment of the present invention, the operation thereof will be described.

When the selector rod 32 is in its fully extended position - that is, when the fork member 37 abuts the stop 41 - the locking pins 42 engage the outer surface of the selector rod 32. Thus, in order to minimize frictional resistance to axial movement of the selector rod 32, the exteme outer ends of the locking pins 42 may be domed or otherwise suitably shaped.

Also, in this fully extended position of the selector rod 32, the key member 22 engages within the keyway 29 of the driven gear 19 thereby operatively connecting that gear to the driven shaft 3 and selecting a first gear ratio.

To obtain a second gear ratio, the selector rod 32 is forced into the housing 4 against the action of its associated spring 39 until a position is reached

where a first one of the locking pins 42 is free to move into its fully extended position under the action of its associated compression spring 47. Upon releasing the selector rod 32, the operating end 33 thereof abuts the extended locking pin 42 and in this position of the selector rod 32 the key member 22 is located to operatively engage within the keyway 28 of the driven gear 18.

Third, fourth or any other possible gear ratio is selected by continuing the inward movement of the selector rod 32 until the operating end 33 passes, and is allowed to abut against, a second or third etc., locking pin 42.

When the keyways 29 and 28 of the first and second selected gears are not aligned before the ratio change is made; during axial movement of the selector rod 32 from the first position to the second position, the key member 22 is initially forced out of the first driven gear keyway 29 and completely into the driven shaft slot 26 by engagement with the end surface of the second selected driven gear 18. The key member 22 is subsequently held in that depressed position (see Figures 4 and 5) by the surface of the bore of the second selected driven gear 18 until it is substantially aligned with the keyway 28 of that gear.

If on the other hand, the keyways of the first and second gears are aligned during the ratio change, the guide washer 51 for those two gears will retain

the key member 22 out of engagement with both keyways 28 and 29 until the gear engaging portion 24 of the key member 22 is located within the longitudinal confines of the second gear keyway 28.

The ends of the keyway bases may be shaped or suitably sloped to facilitate depression of the key member 22 into the driven shaft slot 26 when the key member 22 is moved axially against an end surface of a gear or guide washer 51. Alternatively or additionally, the ends of the bores of the gears and abutment surfaces of the guide washers 51 may be similarly shaped.

When the key member 22 is in the fully depressed position, each gear of the free or driven cluster 7 is free to rotate relative to the driven shaft 3. Thus, if the keyway 28 of the second driven gear 18 is not correctly aligned with the key member 22 immediately after the selector rod 32 has achieved the second position, rotation of all the driven gears relative to the driven shaft 3 is still possible.

However, upon energizing the drive motor so as to rotate the driving shaft 2 and its associated gear cluster 6, consequential rotation of the driven gears relative to the driven shaft will take place. In the course of this rotation, the second driven gear keyway 28 will be aligned with the key member 22 which will then be urged into engagement with that keyway by means of its associated spring 31, thereby drivably connecting the driving and driven shafts.

If it is desired to return the gear box from say the second gear ratio to the first, the first locking pin 42 is forced axially into its associated bore 43 so as to be clear of the operating end 33 of the selector rod 32 and thereby free the selector rod 32 for outward movement under the action of its associated spring 39. The selector rod spring 39 preferably has sufficient strength to overcome the resistance to axial movement of the selector rod 32 which is encountered when the key member 22 engages the blind end of a keyway.

Although the invention has been described in relation to a gear box in which the fixed cluster is mounted on the driving shaft and the free cluster is mounted on the driven shaft, it is to be understood that the fixed and driven cluster could nevertheless be mounted on the driven and driving shafts respectively.

It will be clear from the foregoing description that the present invention provides an improved gear box for power operated tools which simplifies selection of the great ratios.

The claims defining the invention are as follows:

1. A two or more speed gear box according to claim 1 of Australian Patent No. 291,766, neutralising means is provided on said other shaft so as to be engageable with said key member during a change-over from any one gear ratio to another, said neutralising means being operable during said engagement to retain said key member in an inoperative or neutral position.

2. A gear box according to claim 1, wherein said slot is of sufficient depth to contain substantially the whole of said key member during movement thereof along said slot,

and spring means is associated with said key member for constantly urging said part thereof to project laterally beyond the surface of said other shaft; whereby when in use, the key member is adapted to selectively couple any one of the gears of said free gear cluster to said other shaft.

3. A gear box according to claim 1 or 2, wherein said neutralizing means includes a guide member interposed between the keyways of each two adjacent gears of the free cluster, each said guide member being arranged to retain said part of the key member out of engagement with the keyways of its respective two adjacent gears of the free cluster until said part of the key member is positioned longitudinally along said slot to be engageable with one of said keyways only.

4. A gear box according to claim 3, wherein each said guide member is in the form of a washer having an internal diameter substantially the same as the bore diameter of the gears of the free cluster.

5. A gear box according to claim 4, wherein each said washer is mounted within a recess formed within an end face of a respective gear of the free cluster, and is fixed to its respective gear against relative rotation.

6. A gear box according to claim 3 wherein the keyways of at least one gear of each pair of adjacent gears of the free cluster extends from one end face of the gear to adjacent the opposite end face thereof to form an end

wall between the keyway and said opposite end face, said end wall forming one of said guide members.

7. An electric drill or other power operated tool including, a main body, drive means contained within said main body, a gear box according to any one of the preceding claims having said housing removably secured to said main body, said drive means including a spindle projecting into said gear box housing and being drivably connected to said driving shaft, and a tool holding device located outside said housing and being attached to said driven shaft for rotation therewith.

8. A two or more speed gear box for power operated tools having parts constructed, arranged and adapted to function substantially as herein described with reference to the accompanying drawings.

DATED this 13th day of September A.D. 1967

SHER POWER TOOLS PROPRIETARY LIMITED
By its Patent Attorneys:
PHILLIPS ORMONDE & FITZPATRICK

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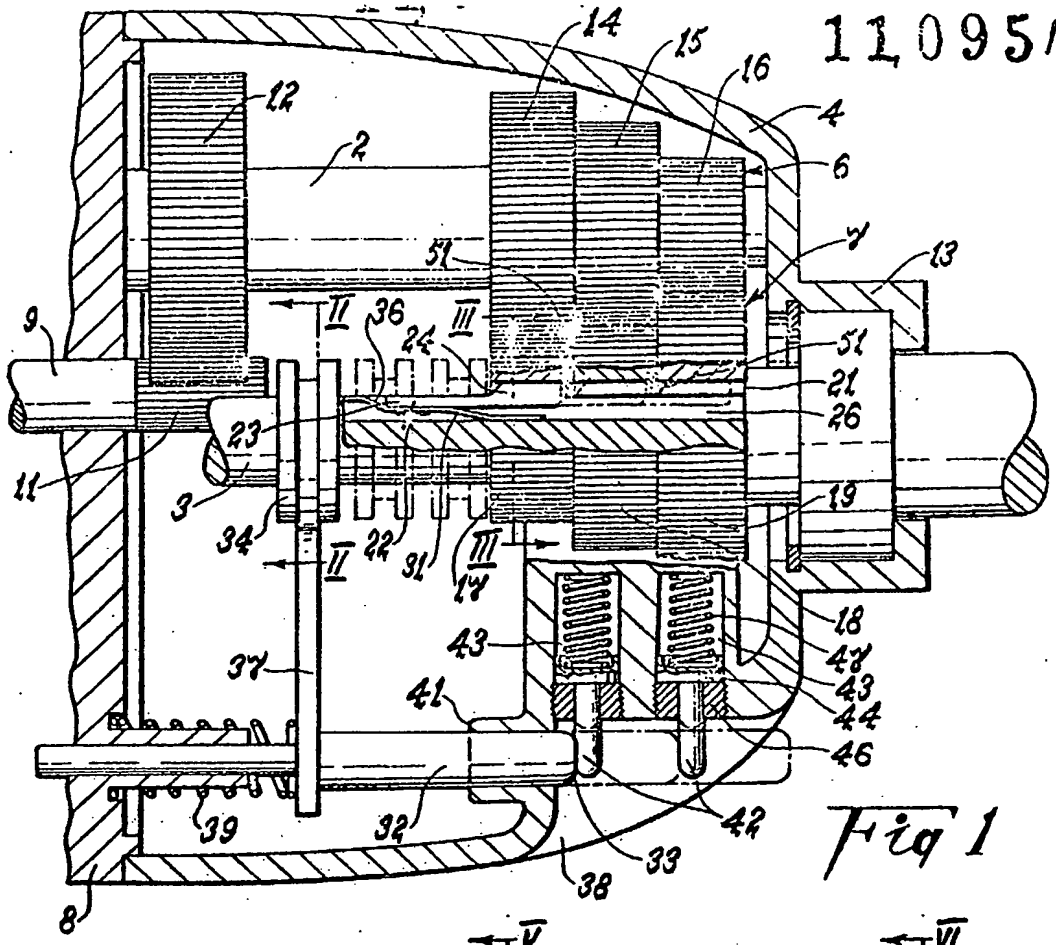

Fig 1

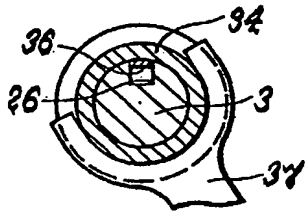

Fig 2

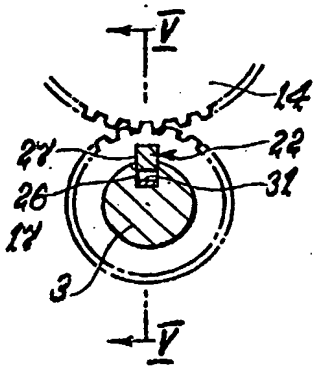

Fig 3

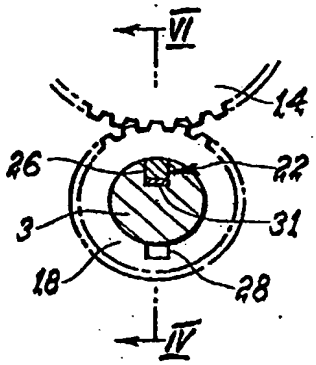

Fig 4

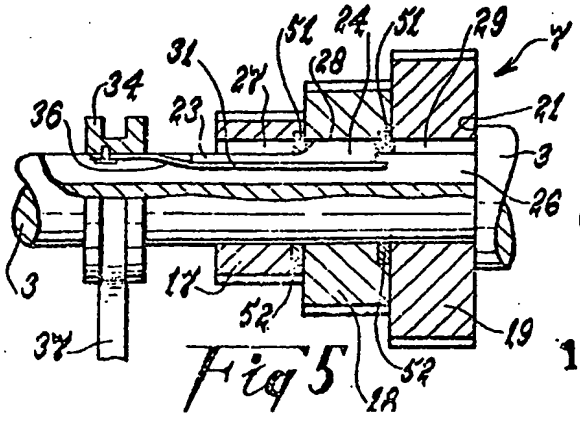

Fig 5

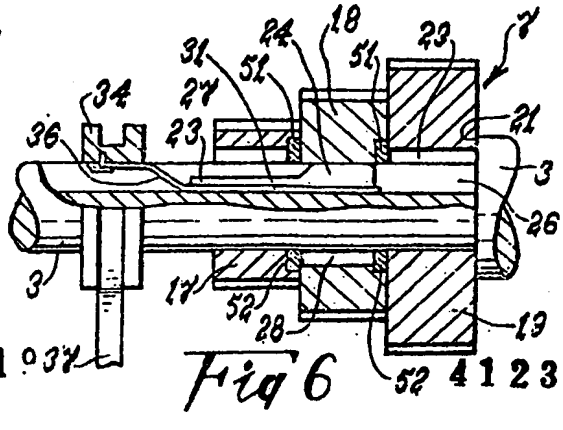

Fig 6

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